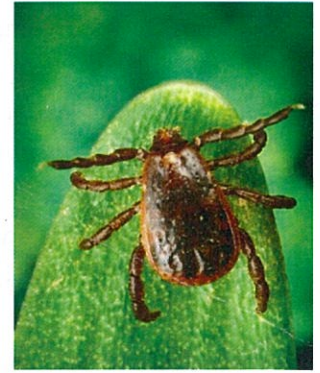


Epidemic Rocky Mountain spotted fever in the Southwest

Background

- ◆ In 2003, Rocky Mountain spotted fever (RMSF) was unexpectedly confirmed by the CDC as the cause of death in a 1 year old American Indian child from Arizona, where RMSF cases had not been previously reported.
- ◆ Upon further investigation, it was found that the bacterium was being transmitted by a new tick-vector, the brown dog tick.
- ◆ Between 2003 and 2014, more than 340 cases and 20 deaths were reported from tribal communities in Arizona.
- ◆ Incidence of RMSF in Arizona is 150 times higher than the average US incidence.
- ◆ The same epidemic Rocky Mountain spotted fever transmitted by the brown dog tick has been observed in parts of Mexico, including Sonora, Baja California, and Coahuila.
- ◆ One large urban outbreak in Mexicali in 2009 resulted in more than 1,000 cases.



Clinical aspects of RMSF

- ◆ Rickettsial diseases begin with non-specific symptoms, such as fever, headache, and gastrointestinal illness, and progress rapidly into severe illness requiring hospitalization, or even resulting in death.
- ◆ When left untreated, the bacteria can cause damage to blood vessels throughout the body leading to organ and tissue damage.
 - Life-altering outcomes can include amputation of extremities (from lack of blood flow) and neurological deficits (such as hearing loss, paralysis, and encephalopathy).
 - More than 20% of untreated cases will be fatal with the average time from onset to death only 8 days.

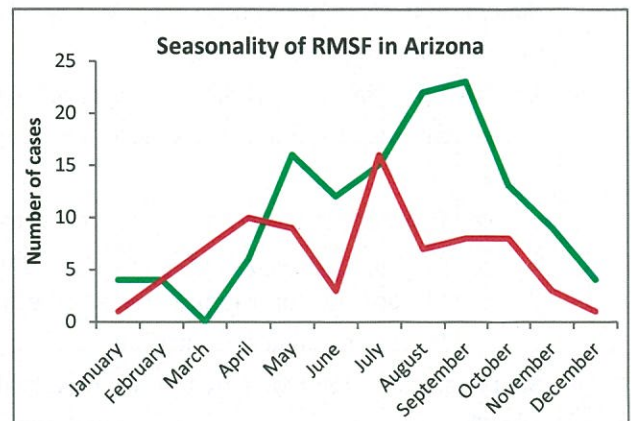


Late stage manifestations of Rocky Mountain spotted fever

- ◆ Doxycycline is most effective treatment for rickettsial disease in patients of all ages when given within the first 5 days of illness.

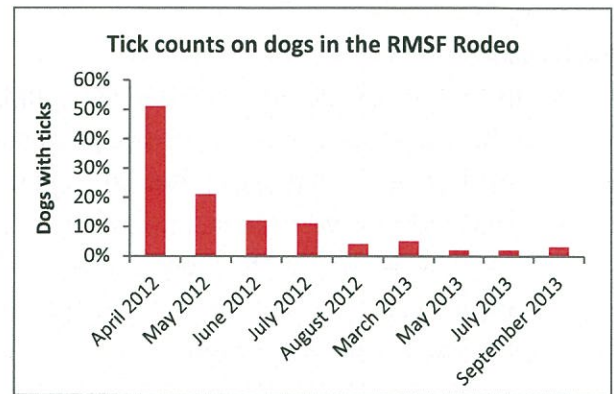
Epidemiology of RMSF in the Southwest

- ◆ RMSF cases in Arizona and parts of Mexico are transmitted by brown dog ticks which preferentially feed on domestic dogs.
- ◆ Dogs may bring brown dog ticks into the domestic and peridomestic setting increasing human risk of exposure to RMSF.
- ◆ Dogs can be effectively treated with acaricide products such as collars and spot-ons.
- ◆ RMSF cases occur year-round in Arizona, with peak activities in June and September following monsoon rains.
- ◆ Children are the most highly impacted age group with case fatality rates as high as 55% (reported from Coahuila, Mexico).



Prevention of RMSF in Arizona

- The RMSF Rodeo was designed to reduce disease-carrying ticks in the peridomestic environment (area around the home) by controlling ticks both in the environment and on dogs using:
 - Long-lasting tick collars on dogs
 - Monthly environmental pesticide applications
 - Community based education about tick control methods and disease prevention
- By the end of the first year < 1% of dogs from the RMSF Rodeo community had ticks, compared to 64% of dogs outside the RMSF Rodeo area, and environmental tick counts were reduced below detectable levels.
- In the second year, the project demonstrated the potential for sustained tick control with fewer than 3% of dogs showing tick infestations.
- Human incidence of RMSF was reduced by 43% in the pilot community compared to previous two years and no fatal cases with exposure in the RMSF community have occurred since the start of the project.
- Success of the project resulted in the expansion of this project to other highly impacted areas. The RMSF Rodeo project continues to serve as a model for other local and international communities seeking to reduce RMSF transmitted by the brown dog tick.



Cost of RMSF in Arizona

- ◆ An estimated \$13.2 million in losses linked to the epidemic of RMSF between 2002 and 2011 from costs associated with medical care, loss of productivity, and death.
- ◆ The average cost per death from RMSF (\$775,467) is more than five times that of pneumococcal disease (\$140,862) in the United States.
- ◆ More than half of RMSF deaths were among children, raising the long-term social costs of the epidemic.
- ◆ Medical expenses and lives lost cost four times more than RMSF prevention programs.

Future needs for RMSF in the Southwest

- ◆ Six tribes have identified human cases of RMSF resulting from exposure on tribal lands, placing more than 350,000 Native Americans at risk for RMSF in Arizona.
- ◆ While much momentum in the RMSF battle has been gained, sustainable RMSF prevention programs are vital for long-term tick control and disease reduction.
- ◆ Effective programs will require continued intervention and follow-up to permanently disrupt the tick cycle. Primary program components include:
 - Providing effective tick control resources
 - Building capacity in animal control programs
 - Supporting community education efforts
 - Increasing clinical education on recognition and treatment of RMSF
- ◆ Sustainable tick control activities are essential to prevent RMSF related death and disability in the US and in Mexico.





Developing New Tests for Zika, Chikungunya, and Dengue

Zika can cause severe birth defects. Chikungunya causes debilitating joint pain. Dengue can be deadly. All are spread by *Aedes aegypti* and *Aedes albopictus* mosquitoes. When a person gets sick, these diseases can be difficult to diagnose. Healthcare providers may order tests to help confirm a diagnosis. DVBD researchers developed the international “gold standard” tests for Zika virus infection—one detects Zika virus RNA, the other detects antibodies to Zika virus. These tests provided the foundation for a third DVBD-developed test, the Trioplex, which detects Zika, chikungunya, and dengue virus RNA in one test.



Discovering and Tracking Tickborne Diseases

Tick bites can cause serious infections, such as ehrlichiosis, Lyme disease, and Rocky Mountain spotted fever—some are deadly if not treated promptly with antibiotics. Since 2004, seven new tickborne pathogens have been discovered in people in the United States. More advanced testing methods are needed to help properly diagnose tickborne infections and to discover new pathogens that cause infections.

Over a three-year period, CDC is partnering with the Minnesota Department of Health, Mayo Clinic, the Tennessee Department of Health, and Vanderbilt University to obtain up to 30,000 clinical samples from people who have a suspected tickborne illness. CDC will use Advanced Molecular Detection methods to identify tickborne bacteria that may have caused these patients’ illnesses.



Finding Effective Natural Insect Repellents and Insecticides

Nootkatone, a natural ingredient found in Alaska yellow cedar trees, some herbs, and citrus fruits, is responsible for the distinctive smell of grapefruits. Nootkatone has long been used in many products with a citrus flavor or smell, including the soft drink Fresca. DVBD scientists have found nootkatone to be an effective repellent and insecticide for use against mosquitoes, ticks, and other pests.

Nootkatone appears to work differently compared to available insecticides and may be a valuable option when fighting insecticide resistance in mosquitoes. To expand available insect repellent options, nootkatone could be used in soaps, sprays, and lotions. CDC is working with a commercial partner, Evolva, to evaluate possible formulations. Currently, Evolva is working with the US Environmental Protection Agency to get nootkatone registered as a biochemical insecticide active ingredient. Watch an Evolva video: <http://bit.ly/2bzo4Zv>.

CDC's Division of Vector-Borne Diseases



DVBD Priority Diseases

- Chikungunya virus
- Dengue virus
- Ehrlichiosis & anaplasmosis
- Lyme disease
- Plague
- Rocky Mountain spotted fever
- Tularemia
- West Nile virus
- Zika virus

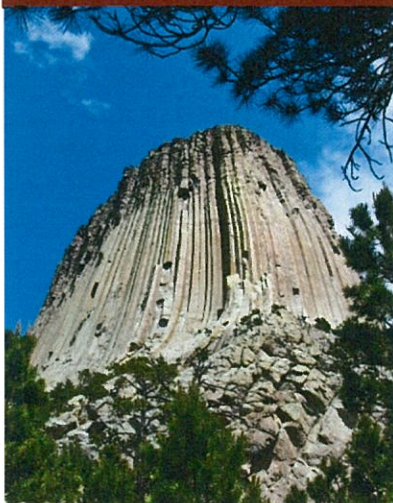
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Virtually everyone on earth is vulnerable to diseases from viruses and bacteria transmitted to people through bites of mosquitoes, ticks, fleas, and other insects, known as vectors. West Nile virus, Lyme disease, and Rocky Mountain spotted fever are some of the more well-known vector-borne diseases in the United States. Dengue virus infections, a major health problem in Puerto Rico, infect as many as 400 million worldwide each year and can be deadly.

Increasing global travel, urbanization, and climate change are contributing to vector-borne disease outbreaks in new regions and countries. These diseases can be difficult to prevent and control, particularly since vaccines are available for only a few vector-borne diseases.

Detecting and Preventing Vector-Borne Diseases

The Division of Vector-Borne Diseases (DVBD) is a national and international leader in researching, preventing, and controlling viruses and bacteria spread by vectors like mosquitoes, ticks, and fleas. Our staff includes entomologists, epidemiologists, molecular biologists, laboratorians, microbiologists, physicians, veterinarians, virologists, and zoologists. DVBD's key activities include:

- Developing cutting-edge laboratory tests for rapid identification and diagnosis of new and known vector-borne diseases.
- Developing guidelines and educating clinicians.
- Working with health departments to monitor vector-borne diseases through surveillance systems. ArboNET, a national surveillance system, tracks vector-borne viruses in people, animals, mosquitoes, and blood donors. TickNET leads collaborative research on tickborne diseases.
- Researching vaccines.
- Partnering with state, local, territorial, and tribal health departments, industry, and international partners, such as the World Health Organization, to quickly detect and respond to outbreaks.
- Educating the public, Congress, and other key audiences.

Responding to Outbreaks

Upon invitation, DVBD provides subject matter expertise and technical support to state, local, territorial, and tribal health departments that are responding to outbreaks. DVBD has recently worked with partners on the following outbreaks:

- Zika and chikungunya viruses in Latin America and the Caribbean
- Dengue in Hawaii
- Sudden cardiac death due to Lyme carditis
- Plague in Yosemite National Park
- Rocky Mountain spotted fever in Arizona and Mexico
- Tularemia in Devils Tower National Monument